INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB 03/03258

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1, 3, 4	as published
2, 5-10	filed with telefax on 27.10.2004

Claims, Numbers

1-26	filed with telefax on 27.10.2004

Drawings, Sheets

1/2-2/2	as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application,

   ☒ claims Nos. 24-26

   because:

   ☒ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

   see separate sheet

   ☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☐ no international search report has been established for the said claims Nos.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the Standard.

   ☐ the computer readable form has not been furnished or does not comply with the Standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-23
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-23
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-23
	No:	Claims	

2. Citations and explanations

see separate sheet

I. Basis of the opinion

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed")*:

Description, Pages

1-10 as originally filed

Claims, Numbers

1-27 as originally filed

Drawings, Sheets

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   - ☐ the description, pages:
   - ☐ the claims, Nos.:
   - ☐ the drawings, sheets:

5. ☐ This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been and will not be examined in respect of:

   ☐ the entire international application,

   ☒ claims Nos. 26, 27

   because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

   ☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☒ no international search report has been established for the said claims Nos. 26, 27

2. A written opinion cannot be drawn due to the failure of the nucleotide and/or amino acid sequence listing to comply with the Standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the Standard.

   ☐ the computer readable form has not been furnished or does not comply with the Standard.

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-3, 5, 6, 9-18, 24
Inventive step (IS)	Claims	4, 7, 8, 19-23, 25
Industrial applicability (IA)	Claims	

2. Citations and explanations

   see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. Claims shall not rely on references to the description and drawings (Rule 6.2(a) PCT).
   Since no search report was established for claims 26 and 27, no establishment of opinion with regard to novelty, inventive step and industrial applicability can be made.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

2. Reference is made to the following documents:
   - D1: WO 02/053084 A (ARCTIC MEDICAL AS ;OLSEN OLE (NO); LEIVSETH GUNNAR (NO)) 11 July 2002 (2002-07-11)
   - D2: US-A-6 039 679 (YU SIMON S C) 21 March 2000 (2000-03-21)
   - D3: EP-A-1 121 956 (BOSCO CARMELO) 8 August 2001 (2001-08-08)
   - D4: EP-A-0 335 616 (SHANKSTER RAYMOND EDWIN) 4 October 1989 (1989-10-04)
   - D5: US-A-4 705 271 (SKOVER JR NICK ET AL) 10 November 1987 (1987-11-10)
   - D6: SU-A-1 447 385 (MIKHEEV ALEKSANDR A ;NIGREEV VLADIMIR S (SU); KAZAKOV SERGEJ F (SU) 30 December 1988 (1988-12-30)

3. Claims 24 and 25 possibly relate to subject-matter considered by this Authority to be covered by the provisions of Rule 67.1(iv) PCT. Consequently, an opinion will be formulated with respect to novelty, inventive step and industrial applicability of the subject-matter of these claims (Article 34(4)(a)(I) PCT) only in matters of a non-therapeutical method.

4. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is not new in the sense of Article 33(2) PCT.

   The document D1 discloses (the references in parentheses applying to this

document) an apparatus suitable for muscular stimulation of a user, which comprises a pressure sensor (15), a control unit (22) to which pressure values sensed by the pressure sensor (15) are fed, and a vibrational stimulator (16) suitable for applying vibrational stimulation, wherein the vibrational stimulator (16) is activated by the control unit (22) in response to the pressure sensor (15) sensing an applied pressure which in use exceeds a threshold pressure value.

Also document D2 discloses all features of claim 1. Claim 1 is therefore not new.

5. The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent method claim 24 (cf. point 3 above), which therefore is also considered not new.

6. Dependent claims 2-23 and 25 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, see documents D1-D6 and the corresponding passages cited in the search report.
In respect of novelty for claims 2, 3, 5, 6, 9-18, 24;
in respect of inventive step for claims 4, 7, 8, 19-23, 25.

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. Claim 24 possibly relates to subject-matter considered by this Authority to be covered by the provisions of Rule 67.1(iv) PCT, see e.g. p. 7, lines 20 and 21. Consequently, no opinion will be formulated with respect to novelty, inventive step and industrial applicability of the subject-matter of these claim (Article 34(4)(a)(I) PCT).

2. Claims shall not rely on references to the description and drawings (Rule 6.2(a) PCT). Therefore, no establishment of opinion with regard to novelty, inventive step and industrial applicability can be made for claims 25 and 26.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

3. The application does not meet the requirements of Article 6 PCT, because claim 1 is not clear. The functional statement in claim 1, see p. 11, lines 10-13, does not clearly define the matter for which protection is sought. Moreover, it is not clear whether a unit can reciprocally move in response to the pressure sensor sensing an applied pressure, or whether the vibrational stimulator can apply vibrational stimulation in response to the pressure sensor sensing an applied pressure. In view of that, the claims have been examined taking into account the description and the drawings, e.g. p. 5, lines 14-31.

4. Reference is made to the following document:
   D1: WO 02/053084 A (ARCTIC MEDICAL AS ;OLSEN OLE (NO); LEIVSETH GUNNAR (NO)) 11 July 2002 (2002-07-11)

5. The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document) an apparatus suitable for muscular stimulation of a user, which comprises a pressure sensor (15), a control unit (22) to which pressure values sensed by the pressure sensor (15) are fed, and a vibrational stimulator (16) suitable for applying vibrational stimulation, wherein the vibrational stimulator (16) is activated by the control unit (22) in response to the pressure sensor (15) sensing an applied

pressure which in use exceeds a threshold pressure value.

The subject-matter of claim 1 differs from this known apparatus in that the vibrational stimulator can apply vibrational stimulation to a user via a unit which in use can reciprocally move relative to the user, the unit being moveable in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT) is also considered as involving an inventive step (Article 33(3) PCT).

6. Claims 2-23 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step (Article 33(2),(3) PCT).

7. Claims 1-23 also meet the requirements of the PCT with respect to (Article 33(4) PCT).

which exceeds a threshold pressure value, and wherein the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure.

The apparatus according to the present invention thus provides vibrational stimulation to a user in response to the pressure sensor sensing an applied pressure by the user above a threshold value. Thus, the user must expend a certain amount of physical effort in order to activate the vibrational stimulator, the amount of physical effort required being determined by the level at which the threshold pressure value is set.

Preferably, the vibrational stimulator is deactivated when the pressure sensor ceases to sense an applied pressure which exceeds the threshold pressure value. In this way, the user must continue to apply a pressure above the threshold value in order for the vibrational stimulator to remain activated, and thereby provide vibrational stimulation to the muscles of the user.

The apparatus according to the present invention may conveniently take the form of exercise apparatus, for example of the type found in a gym.

The apparatus may comprise one or more pressure sensors, and preferably comprises a first set of pressure sensors for detecting pressure applied through the hands of a user, and/or a second set of pressure sensors for detecting pressure applied through the feet of a user. The first and second sets of pressure sensors may each respectively comprise one or more individual pressure sensors. More preferably, the apparatus comprises both said first and second sets of pressure sensors.

For example, the first set of pressure sensors may detect :

respectively.

The vibrational stimulator(s) can preferably deliver vibrational stimulation to a user in a plurality of amplitudes, frequencies and directions. More preferably, the amplitude, frequency and direction of vibration may be tailored by a user via the control unit. Each vibrational stimulator may comprise one or more individual vibration engines, which may be controlled electronically according to parameters stored by the control unit. The vibrational parameters may be manually set by a user prior to use of the apparatus.

The vibrational stimulator(s) can provide vibrational stimulation to a user via a unit which can either reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure or which can remain substantially stationary relative to a user. For example, in the preferred embodiment referred to above, the bar to which a user can apply pressure through their hands can be reciprocally moveable relative to the user, reciprocal movement of the bar being activated in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure, as for activation of the vibrational stimulator. Alternatively, the bar can remain substantially stationary relative to a user. Similarly, in the aforementioned preferred embodiment, the plate to which a user can apply pressure through their feet can be reciprocally moveable, activated in the same way as the bar. Alternatively, the plate can remain substantially stationary relative to a user.

The reciprocal movement may be, for example, substantially

towards and away from the user in the plane of symmetry of the user, laterally in a plane substantially orthogonal to the plane of symmetry of the user, a combination of movements in both of said planes, circular movement in one or both of said planes, or a combination of any of such movements. Preferably, the direction(s) of the movement may be predetermined by the user, for example by pre-programming the control unit (e.g. via a touch screen display), as preferably may also the speed and magnitude of the reciprocal movement.

Thus, in use, a user of the apparatus according to the present invention applies an initial pressure to be sensed by the pressure sensor. The initial pressure is preferably the maximum pressure which the user can apply at that instant. The pressure sensor senses the initial pressure value, which is stored by the control unit. A threshold pressure value is then determined based upon the initial pressure value. The threshold pressure value may be any value from 0% (i.e. no pressure is required by a user to activate vibrational stimulation) to 100% (i.e. vibrational stimulation is only activated when a pressure equal to or exceeding the initial pressure value is sensed) of the initial pressure value, for example from 50 to 90% of the initial pressure value, or a narrower range of for example 70 to 80%. The threshold pressure value may be automatically set by the control unit, or may be manually set by the user.

Subsequently, each time the pressure sensor senses a pressure applied by the user which exceeds the threshold pressure value, the control unit activates the vibrational stimulator. Preferably, as referred to above, when the pressure sensor senses that the pressure applied by the user has dropped below

the threshold value, the control unit deactivates the vibrational stimulator. Thus, the user will only receive vibrational stimulation when sufficient pressure is applied to activate the vibrational stimulator, according to the threshold pressure value stored by the control unit, for example as previously manually set by the user.

According to the present invention there is thus also provided a method for operating the above-described apparatus, which method comprises the user applying an initial pressure which is sensed by a pressure sensor, recording the initial pressure value sensed by the pressure sensor, and applying vibrational stimulation to the user by a vibrational stimulator in response to the user applying pressure to the pressure sensor which exceeds a threshold pressure value determined by the initial pressure value.

The apparatus and method according to the present invention thus have utility for exercising muscles, either as part of a fitness regime, or a recovery program of a user from surgery or illness. The apparatus and method according to the present invention have the particular advantage over prior apparatus and methods in that they may be specifically tailored by the user to individual requirements. The apparatus and method according to the present invention may be used as an evaluation tool for neuromuscular performance, to stimulate different muscles and joints in a user, and allows exercise or treatment at different levels of force applied by a user. However, the apparatus and method according to the present invention is also suited for use in microgravity environments, for example beyond the earth's atmosphere, where exercising with weights, for example barbells, is ineffective.

An embodiment of the present invention will now be described in detail by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a preferred embodiment of the apparatus according to the present invention; and
Figure 2 is a top view of the embodiment shown in Figure 1.

Referring to Figures 1 and 2, a preferred embodiment of the apparatus of the present invention comprises first and second pressure sensors 2 and 4 respectively, in the form of first and second strain gauges, a control unit 6 to which pressure values sensed by the pressure sensors 2 and 4 are fed, and first and second vibrational stimulators 8 and 10 respectively for applying vibrational stimulation to the user. The pressure values detected by the first and second pressure sensors 2 and 4 are fed to the control unit 6 via connections 12. The apparatus further comprises a touch screen display 14 by which the user may view in real time their performance on the apparatus, and may input or change apparatus parameters, for example the threshold pressure value, or parameters of the vibrational stimulators 8 and 10.

As shown in Figures 1 and 2, the preferred embodiment of the apparatus according to the present invention is designed for use by a supine user. The first pressure sensor 2 and first vibrational stimulator 8 form part of a unit which comprises a bar 16 against which the user pushes through their hands to apply pressure thereto. The second pressure sensor 4 and second vibrational stimulator 10 form part of a unit which comprises a plate 18 against which the user pushes through their feet to apply pressure thereto.

The bar 16 and/or plate 18 are reciprocally moveable relative to a user in response to the first and/or second pressure sensors 2 and/or 4 respectively sensing an applied pressure which exceeds the threshold pressure. Thus, in the embodiment shown in Figures 1 and 2, the bar 16 is reciprocally moveable towards and away from the direction of applied pressure through the arms of the user (i.e. upwards and downwards in the view shown in Figure 1) and/or the plate 18 is reciprocally moveable towards and away from the direction of applied pressure through the feet of the user (i.e. left and right in the view shown in Figure 1). The direction, speed and magnitude of reciprocal movement of the bar 16 and plate 18 may be pre-determined by the user via the touch screen display 14. Thus, the user can choose to have the bar and/or plate remain substantially stationary relative to the user.

Thus, in use, in the supine position the user initially applies pressure to the bar 16 and plate 18 to their maximum ability. These initial pressure values are sensed by the first and second pressure sensors 2 and 4, and are stored in the control unit 6. The user then sets the threshold pressure value, for example 70% of the initial pressure value, using the touchscreen 14. The user then applies pressure to the bar 16 and plate 18, and whenever the first and second pressure sensors 2 and 4 sense pressure values greater than the threshold value, the control unit 6 activates the first and second vibrational stimulators 8 and 10, to thereby stimulate the arm and leg muscles respectively of the user. When the pressure value sensed by the first and/or second pressure sensors 2 and 4 drops below the threshold pressure value, then the control unit 6 deactivates the first and/or second vibrational stimulators 8 and 10 accordingly. As referred to hereinabove, the bar 16 and/or plate 18 are reciprocally

moveable relative to the user in response to the first and/or second pressure sensors 2 and/or 4 respectively sensing an applied pressure which exceeds the threshold pressure.

It will be understood that the embodiment illustrated describes the invention in one form only for the purposes of illustration. In practice, the invention may be applied to many different configurations, the detailed embodiments being straightforward for those skilled in the art to implement.

CLAIMS

1. Apparatus for muscular stimulation of a user, which apparatus comprises a pressure sensor, a control unit to which pressure values sensed by the pressure sensor are fed, and a vibrational stimulator for applying vibrational stimulation to a user, wherein the vibrational stimulator is activated by the control unit in response to the pressure sensor sensing an applied pressure which exceeds a threshold pressure value and wherein the vibrational stimulator can apply vibrational stimulation to a user via a unit which can reciprocally move relative to a user in response to the pressure sensor sensing an applied pressure which exceeds the threshold pressure.

2. Apparatus according to claim 1 wherein the vibrational stimulator is deactivated when the pressure sensor ceases to sense an applied pressure which exceeds the threshold pressure value.

3. Apparatus according to claim 1 or 2 which comprises a first set of pressure sensors for detecting pressure applied through the hands of a user, and/or a second set of pressure sensors for detection of pressure applied through the feet of a user.

4. Apparatus according to claim 3 which comprises both said first and second sets of pressure sensors.

5. Apparatus according to claim 3 or 4 wherein the first set of pressure sensors detects pressure applied to a bar against which a user can push or pull with their hands.

6. Apparatus according to any one of claims 3, 4 or 5

wherein the second set of pressure sensors detects pressure applied to a plate against which a user can push with their feet.

7. Apparatus according to any preceding claim wherein the pressure sensor comprises a strain gauge.

8. Apparatus according to any preceding claim for use by a supine user.

9. Apparatus according to any preceding claim wherein the control unit comprises a central processing unit.

10. Apparatus according to any preceding claim wherein the control unit allows a user to set the frequency, amplitude and/or direction of vibrations generated by the vibrational stimulator, and/or stores information concerning use of the apparatus by a user.

11. Apparatus according to any preceding claim further comprising display means for viewing during use of the apparatus by a user.

12. Apparatus according to any preceding claim which comprises a corresponding number of vibration stimulators and pressure sensors.

13. Apparatus according to claim 12 which comprises a first vibrational stimulator associated with a first set of pressure sensors for detecting pressure applied through the hands of a user, and/or a second vibrational stimulator associated with a second set of pressure sensors for detecting pressure applied through the feet of a user.

14. Apparatus according to claim 13 wherein the first set of pressure sensors and first vibrational stimulator are associated with a bar against which a user can push or pull with their hands.

15. Apparatus according to claim 13 or 14 wherein the second set of pressure sensors and second vibrational stimulator are associated with a plate against which a user can push with their feet.

16. Apparatus according to any preceding claim wherein the vibrational stimulator can deliver vibrational stimulation to a user in a plurality of amplitudes, frequencies and/or directions.

17. Apparatus according to claim 16 wherein the vibrational stimulator comprises one or more individual vibration engines, which are controlled electronically according to parameters stored by the control unit.

18. Apparatus according to claim 17 wherein the parameters are manually set by a user prior to use of the apparatus.

19. Apparatus according to any preceding claim which comprises a bar to which a user can apply pressure through their hands, which bar is reciprocally moveable relative to the user.

20. Apparatus according to any preceding claim which comprises a plate to which a user can apply pressure through their feet, which plate is reciprocally moveable.

21. Apparatus according to any preceding claim wherein the

reciprocal movement is substantially towards and away from a user in the plane of symmetry of the user, laterally in a plane substantially orthogonal to the plane of symmetry of a user, a combination of movements in both of said planes, circular movement in one or both of said planes, or a combination of any of such movements.

22. Apparatus according to any preceding claim wherein the direction(s), speed and/or magnitude of the reciprocal movement may be predetermined by the user via the control unit.

23. Apparatus according to any preceding claim wherein the unit can remain substantially stationary relative to a user.

24. A method for operating apparatus as defined in any one of claims 1 to 23, which method comprises the user applying an initial pressure which is sensed by a pressure sensor, recording the initial pressure value sensed by the pressure sensor, and applying vibrational stimulation to the user by a vibrational stimulator in response to the user applying pressure to the pressure sensor which exceeds a threshold pressure value determined by the initial pressure value.

25. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

26. A method substantially as hereinbefore described.